

Transparent conductive film Transparent  
Electromagnetic Wave Shielding

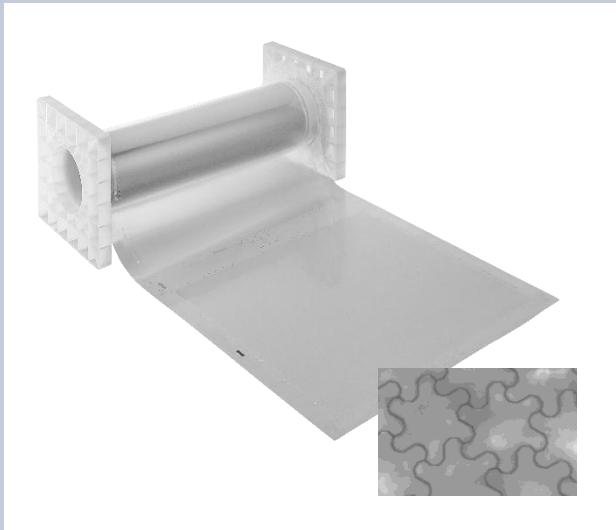
Roll type ( with OCA )

Individual Item Catalog

**IN Your  
Future**

# Roll type ( with OCA )

**Advanced EMC Solutions in Transparent Applications. Enabling efficient noise suppression with reduced component count and simplified integration**



## FEATURES

- High Transparency with Outstanding EMI Shielding Effective across a broad frequency range
- Ultra-Fine Copper Mesh Patterning Achieved with our proprietary microfabrication technology
- Pre-Applied OCA ( Optical Clear Adhesive ) Ensures convenient and clean installation
- Thin, Lightweight, and Flexible Film Format
- Maximizes design freedom and integration flexibility

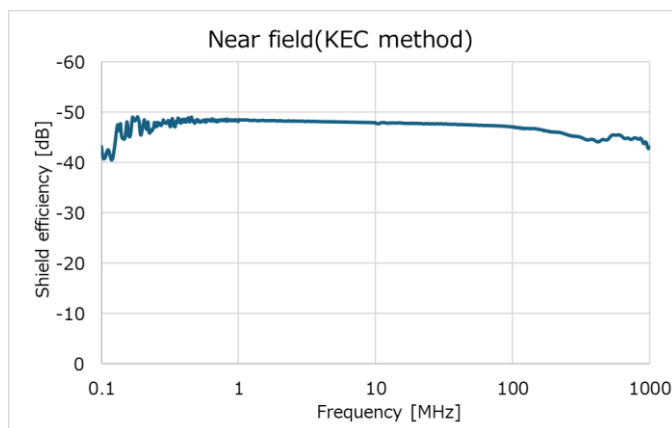
## MAIN APPLICATION

- Noise Shielding
  - Display / Monitor
  - Industrial Machinery, wireless testing equipment, etc.
- Radio wave environment setup
  - RFID ( restriction of radio wave area )
  - Wi-Fi ( anti-interference ) , etc.

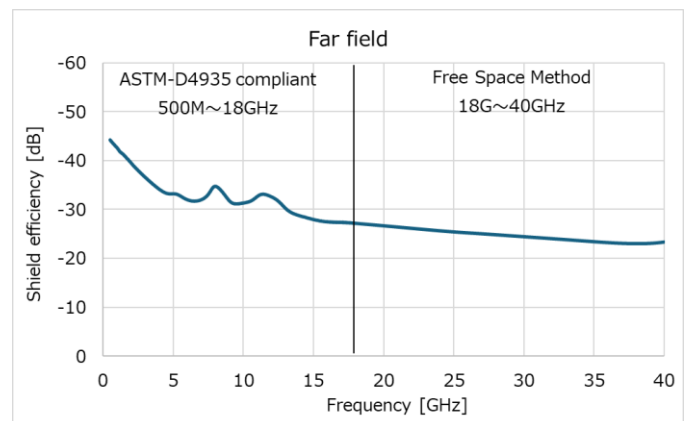
## DETAILED FEATURES

- Brance High Transparency and High EMC Shielding with Broad-spectrum

1. KEC method ( 100 k to 1 GHz ) \*



2. Coaxial tube method ASTM-D4935 compliant ( 500 M to 18 GHz ) / Free space method ( 18 G to 40 GHz ) \*



\*Data are for reference only and are not guaranteed.

- Proprietary Ultra-Fine Copper Mesh Technology

- Provides stable EMI shielding over a broad frequency range by
  - Copper lines: 2.4  $\mu\text{m}$  width, 85  $\mu\text{m}$  pitch on average\*1
  - Delivers low sheet resistance: Max. 1.1  $\Omega/\text{sq.}$ \*2
  - 84%\*1 transmittance.
- High electromagnetic shielding performance in a wide frequency band.

- Anti-Deflection

By adopting a unique wiring pattern, the deterioration of visibility due to light scattering, which is a problem with conventional copper mesh grating wiring, is reduced.

\*1: This is a representative value and is not a standard value or guaranteed value.

\*2: For details, please contact our company sales representative.

# Transparent conductive film Transparent Electromagnetic Wave Shielding

## PART NUMBER

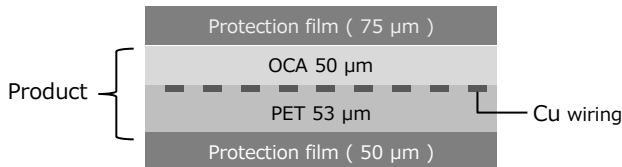
1 2 3 4 5 6 7 8 9 10 11 12  
 E M A 0 6 0 0 0 0 3 B 0

## SPECIFICATIONS

This product is a transparent conductive film for Transparent electromagnetic wave shielding.

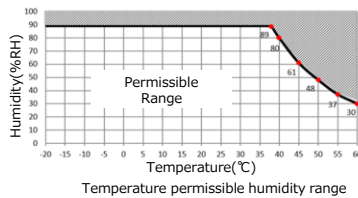
### Stack up

Please remove the protective film on both sides before use.



### Performance

Item		Details
Film substrate		PET ( Polyethylene Terephthalate )
Dimensions ( 1 sheet )	External shape	558.9 mm: MD ( Machine Direction ) ※1 620.0 mm: TD ( Transverse Direction ) ※1
	Pattern area	477.3 mm: MD ( Machine Direction ) ※1 531.5 mm: TD ( Transverse Direction ) ※1
Thickness ( Dimensions )		103 μm ( excluding protection film ) ※1
Wiring	Material	Copper
	Wiring Width	2.4 μm ( Representative value ) ※1
	Average inter-wire pitch	85 μm ( Representative value ) ※1
Characteristics	Total light transmission	84%※1, (Min. 80 % ※1)
	Sheet resistance	1.1Ω/□※1, (Max. 2.6 Ω/sq.※1※2)
Recommended Operating Conditions	Operating Temperature Range*※1	Temperature: -20 to +60° C (at atmospheric pressure), without condensation or freezing. Humidity: Varies depending on temperature; see the figure below. Before use, please verify and evaluate the product under the actual temperature and humidity conditions of your operating environment at your company.
Quantity/Carton		128 Sheets ( approx. 72 m ) /1 Roll



Notes) 1: The unit of order must be the number of packaging boxes.

If you would like to cut the film or order less than the number of packaging boxes, please contact our sales representative.

2: Before using the product, please refer to " Precautions for Use of Transparent Electromagnetic Wave Shield " and " Orders and Precautions for Use. "

3: When using the product at temperatures and humidity other than the operating conditions, please check and evaluate the conditions of use for your company products.

4: The standard temperature and humidity for each characteristic measurement are normal temperature and normal humidity (Temperature +5 to +35 °C, humidity 45 to 85 % RH) . However, if the measurement result is questionable or if reproducibility is required, the test should be conducted in an environment where the product is left at +23 ±5 °C and 65

±10 % RH

for at least 24 hours.

5: Each warranty item shall be individually agreed upon. In the absence of such agreement, no warranty shall be deemed applicable.

\*1: Reference value, not standard value or guaranteed value.

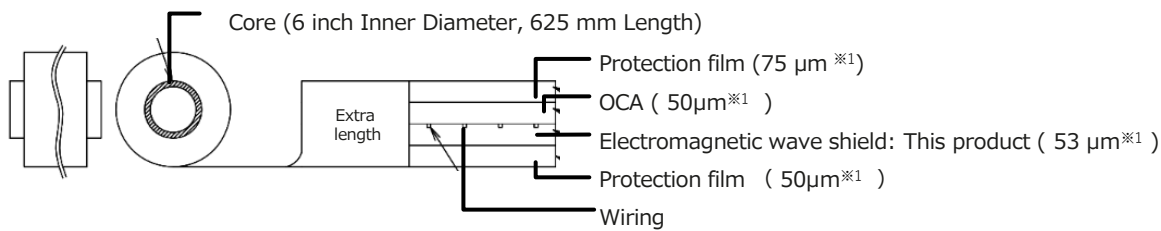
\*2: For more information, please contact your our company sales representative.

# Transparent conductive film Transparent Electromagnetic Wave Shielding

## Dimensions (Unit: mm)

**CAD** CAD data can be downloaded from the Control Equipment website for products with CAD marks.

### Product structure overview

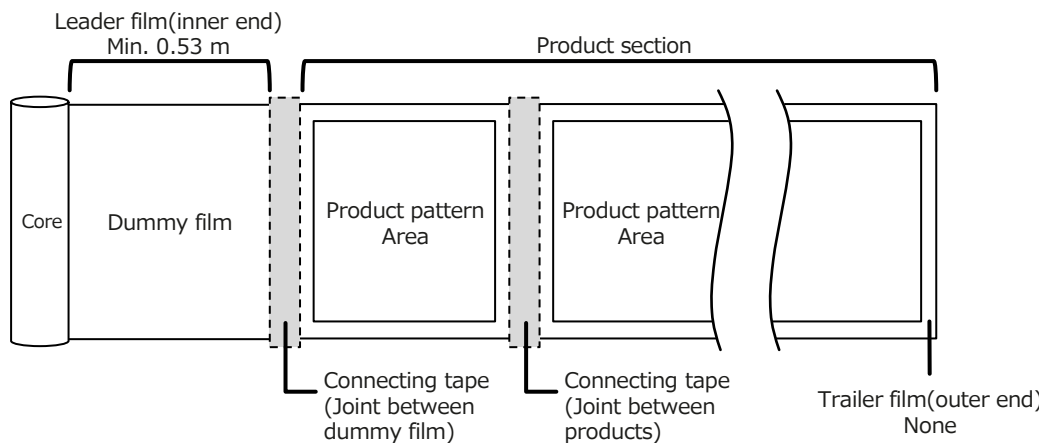


### Leader Film (Extra Length Section)

- Inner end: Min. 0.53 m (Dummy area is marked as X)
- Outside end: None

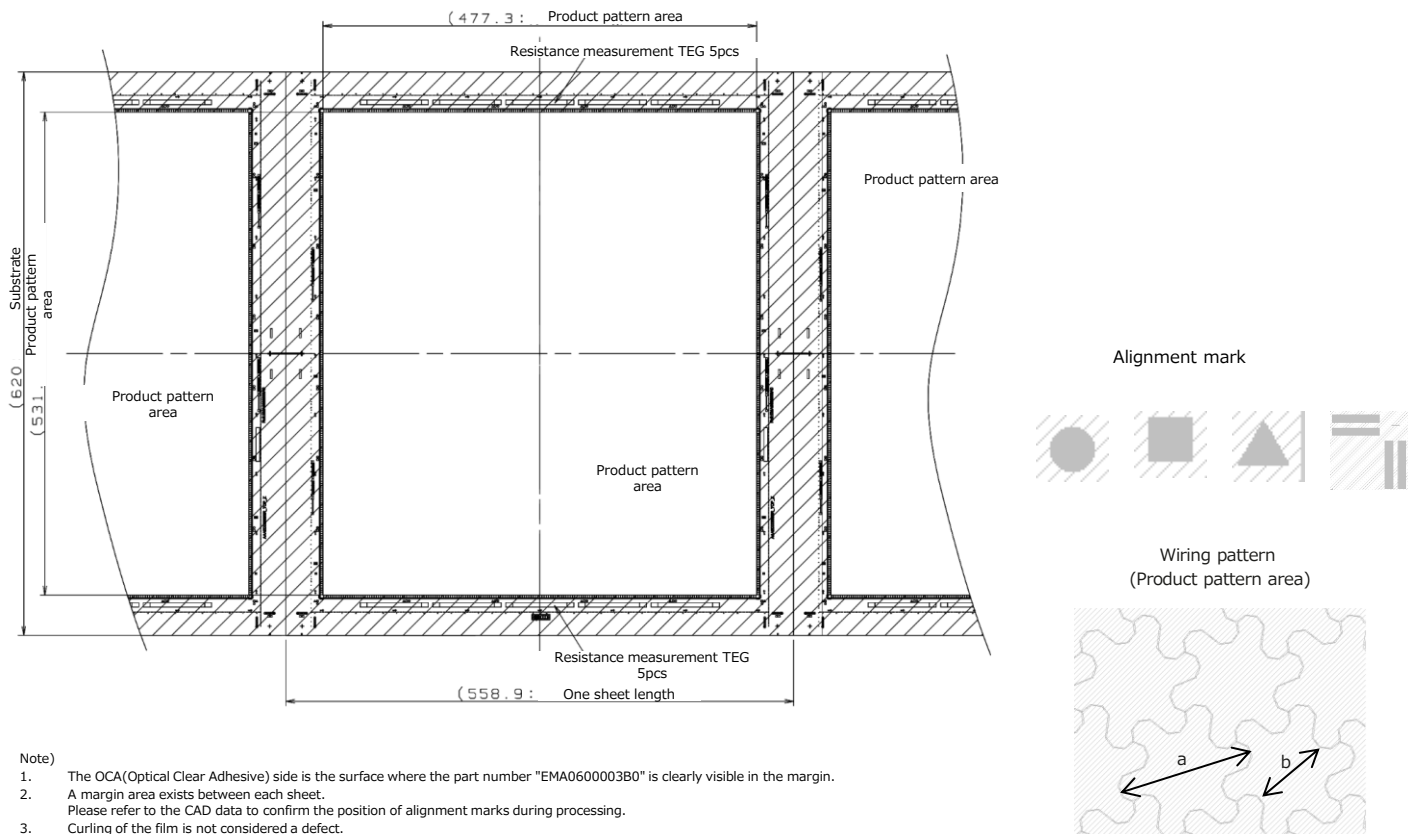
#### Note)

A dummy film is connected to the product section with tape at the inner roll leader. Indentations or steps caused by the taped joint are not considered defects. When removing the tape, please take care not to peel off the protective film.



### Product pattern area

Outline dimensions drawing Unit: mm



#### Note)

1. The OCA(Optical Clear Adhesive) side is the surface where the part number "EMA060003B0" is clearly visible in the margin.
2. A margin area exists between each sheet. Please refer to the CAD data to confirm the position of alignment marks during processing.
3. Curling of the film is not considered a defect.
4. The electrode color differs depending on the viewing side:
  - OCA side: Copper
  - PET side: Gray

$$\text{Average pitch} = \frac{a (\text{the widest pitch}) + b (\text{the narrowest pitch})}{2}$$

# Transparent conductive film Transparent Electromagnetic Wave Shielding

## Reference data

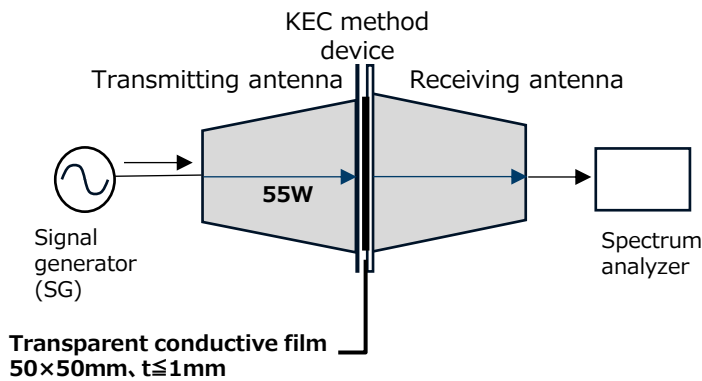
Reference data. This is not a guaranteed value.

### ■ OCA characteristics

	Adhesion surface	Adhered duration	Measurement result [N/25mm]	Test setup and measurement method
Adhesive force [N/25mm]	Glass	1 minute	12.3	• Based on JISZ 1528 • 1800 peeling • Peeling speed: 300 mm/min • Sticking temperature, measurement temperature: +23 ° C50%RH
		24 hour	14.6	
	PET	1 minute	11.3	
		24 hour	12.7	

### ■ Power resistance evaluation ※1※2

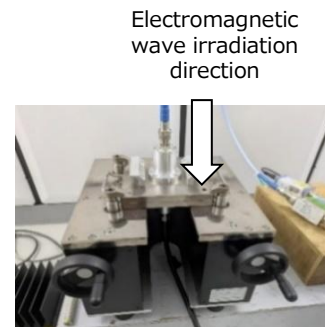
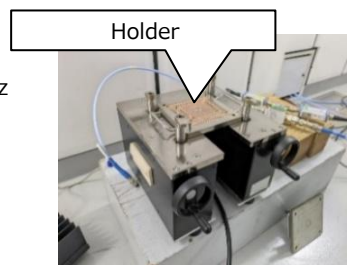
#### ● Evaluation equipment setup



The RF signal is transmitted from the signal generator, and the measurement sample is sandwiched between the transmitting and receiving antennas to prevent the diffusion of radio waves and to directly irradiate the measurement sample with irradiation power.

#### ● Evaluation conditions

- Evaluation device: KEC method device
- Electromagnetic wave frequency: 2.5 GHz
- Irradiation power: 55 W
- Irradiation time: 1 hour



KEC method device

#### ● Evaluation results

Irradiation power of 55 W does not affect sheet resistance.

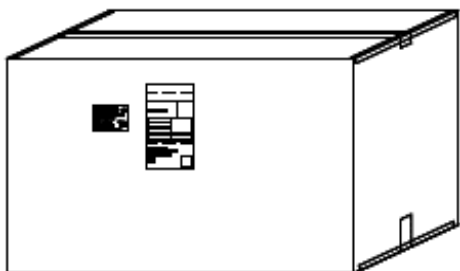
	Sheet resistance value (Ω/sq)	
	Before measurement	After measurement
Irradiation from substrate side	1.076	1.022
Irradiation from OCA side	1.076	1.045

\*1: This is not a standard value or guaranteed value.

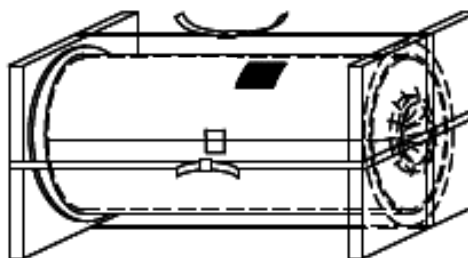
\*2: For details, contact your our company sales representative.

## Packaging Conditions

### ■ Exterior packaging Box



### ■ Inner Roll Packaging



Note)

1. In order to increase the reliability in practical use, be sure to confirm the quality of the product under actual use.
2. Be careful not to scratch the product such as a blade.
3. Do not place the product directly after taking it out.

## Precautions

- Before using the product, please refer to "Precautions for Use of Electromagnetic Wave Shield" and "Orders and Precautions."

# Precautions for Use of Electromagnetic Wave Shield

## Use of this product

This product is a transparent conductive film for electromagnetic wave shielding purpose.

## Cautions for Handling

### ■ Operating Environment

We cannot guarantee the performance of the product if failures occur due to the following usage environments.

1) If used in an indoor environment as specified in this specification, where corrosive gas concentrations are high, or under extremely high temperature and humidity, or in water, failures may occur.

There is a possibility of discoloration, color change, or other deterioration.

2) Do not use the product in environments exposed to sunlight, whether outdoors or indoors.

There is a possibility of discoloration, color change, or other deterioration.

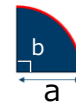
3) This product is designed for indoor electromagnetic shielding applications. To avoid the risk of fire, please sufficiently evaluate heat generation due to radiated electromagnetic power before use.

### ■ Mechanical Design

1) The appearance (color tone) of the copper electrode differs when viewed from the top side and bottom side.

2) When applying this product to a curved surface, please use it only on surfaces with a curvature radius of R30 or larger and within a bending angle of up to 90°. If the product edge is close to the curved surface, peeling may occur. Please use it after verification. Also, do not use it in areas where repeated bending stress is applied.

Image of curved surface



a: 30 mm or more  
b: Within 90°

3) 3D curved surface bonding is not envisioned. Sheet wrinkles, disconnections, etc., may occur.

4) This product is composed of adhesive materials that cannot be re-bonded. Do not re-bond it.

Also, do not peel off the OCA (Optical Clear Adhesive). Please confirm and evaluate adhesion and adhesive strength at your company.

### ■ Precautions for Mounting and Assembly

1) Transparency is an important function of the product. To prevent fingerprints and dirt from adhering to the product, wash your hands, and wear a finger cap, gloves or mask, and handle the Product with an area free of patterns. Also, do not place heavy, hard, or sharp objects on the product.

2) Processing in a cleanroom is recommended for this product.

3) When handling the product, such as during mounting or assembly, do not apply a strong load to the product.

4) When removing the protective film, be careful not to break the wiring due to ESD by using an ionizer to remove static electricity. Remove the protective film at a speed of 10 cm/sec or less (equivalent to a charge of approximately 400 to 600 V or less during removal). Also, when removing, do not apply a strong load such as breaking the film.

5) Avoid impact or damage during transportation and storage. Avoid contact with moisture, especially during transportation in rainy weather.

6) Please note that condensation on the product may cause deterioration in performance.

7) Do not use solvents to clean the Product. If the Product is cleaned with solvents, the Product characteristics may be affected. If the Product is used with the substrate exposed and comes into contact with the substrate for cleaning, verify the wear resistance and hardness according to your company's operating conditions.

8) Depending on the cutting method, there is a possibility of pattern and OCA peeling from the cut edge, so please verify the process conditions in advance. For this product, the use of a cutter or a rotary cutter (scribe) is recommended. Do not use laser cutting. When cutting, clean the cutter area and ensure that no foreign matter or oil adheres to the cut surface.

9) It is recommended to seal the cut edge after cutting the transparent conductive film product.

Very rarely, discoloration may occur around the cut edge.

10) The product may cause defects depending on the materials used. Evaluate the compatibility of the Product with the assembled components in advance, including a reliability test after assembly. In addition, please ensure that the surface to be laminated is free from contamination and foreign matter.

### ■ Cautions for Storage

Store under the following environmental conditions.

1) Avoid storing in locations with high concentrations of corrosive gases such as sea breeze, Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, NO<sub>x</sub>, etc.

2) Do not store in direct sunlight.

3) Store the product in its packaged state, wrapped in a poly sheet, without applying stress.

4) Store within a temperature range of 0 to 35 °C and humidity of 50 %RH or less.

5) To prevent winding misalignment, store the film vertically.

6) Use the film as soon as possible. If it is necessary to store the film in an environment other than the above temperature and humidity, check and evaluate your company before storing.

### ■ Remarks

The conformance of this product is guaranteed as follows :

•RoHS (Restriction of Hazardous Substances in Electrical and Electronic Equipment) Directive [2011/65/EU as amended by (EU) 2015/863] is complied with.

We do not guarantee any compatibility or other characteristics not specified in this document.

The term "compatibility or characteristics not specified herein" refers to the following items.

1) In cases where this product is incorporated into or used in combination with other products:

(i) compatibility with such other products, (ii) operation and performance, and (iii) non-infringement of third-party intellectual property rights.

2) Compliance with applicable laws and regulations.

3) Compliance with various standards and certifications.

# Precautions for Use of Electromagnetic Wave Shield

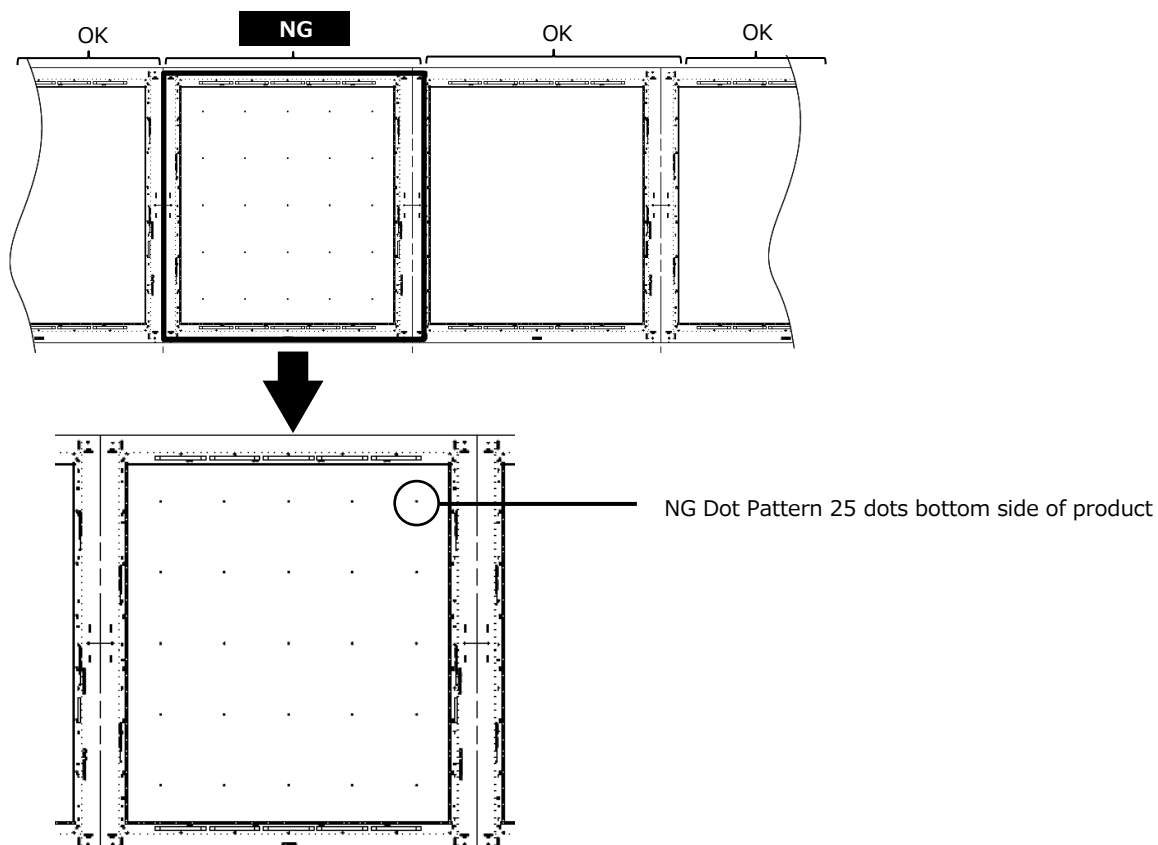
## Cautions for Unpacking

- 1) Confirm the top and bottom direction before unpacking.  
Do not use cutters or other sharp objects when unpacking.
- 2) Take the product out of the cardboard box.
- 3) Remove bands, protectors, etc.
- 4) Take the product out of the poly sheet.

- Attention:  
Be careful not to damage the product with cutters or other tools. Do not place the removed product directly on the floor.

## Identification Method for NG Products

Sheets found to be non-conforming during the process inspection will be marked with dots as shown in the diagram. Do not use any sheets with these dot markings.



# Precautions when ordering and using

This content applies to "Electromagnetic Shield."

## Handling of this catalog

### ■ Application of this catalog

This catalog (including information and data on the website) describes the performance of this product alone.

### ■ Changes to this catalog

Among this product and its specifications, our group (refers to our company, its parent company, and its subsidiaries and affiliates.) may change the design, materials, construction method, packaging, manufacturing site, and other specifications relating to the technical know-how and other intellectual property rights owned by Panasonic without prior notice, for reasons such as product improvement, rising prices of raw materials, or otherwise.

Please contact the Mechatronics Division of our company Industries, Ltd. (hereinafter "Panasonic") to confirm that the information contained in this catalog is up-to-date when considering mass production design or placing an order.

## Safety Compliance Requirements

This product is designed and manufactured for use in general electronic equipment. While our company continuously strives to improve the quality and reliability of the Product, electrical components and devices generally have a certain probability of failure, and their durability varies depending on the usage environment and conditions. Please observe the following requirements when using the Product:

- 1) Before using the Product, evaluate and verify it under actual operating conditions and in the mounted/implemented state, in accordance with the actual manner in which The Product will be used.
- 2) Continued use of the Product after performance deterioration has occurred (for example, when the Product no longer satisfies the quality or performance requirements described in this Specification) may result in abnormal heating, smoke generation, or fire due to insulation deterioration or other similar causes. If performance has deteriorated, discontinue use immediately.
- 3) To prevent personal injury, fire accidents, social damage, or other losses that may result from failure or end-of-life of the Product, implement appropriate safety measures, such as redundant design, fire-spread prevention design, and malfunction prevention design, and conduct adequate safety testing. If any doubts or concerns arise regarding the safety of the Product, discontinue use immediately and promptly notify us.

## Limitation of Use

We classify the applications of products as follows:

Standard Applications	Computers, office automation equipment, communication devices, audio-visual equipment, home appliances, machine tools, personal devices, industrial robots, and automotive parts and equipment, or items used therein (limited to standard automotive applications only). (All of the foregoing excludes parts, equipment, or items used in applications that require a high degree of safety standards, collectively the "Equipment".) Standard automotive applications refer to uses that do not involve driving-related functions ("driving, turning, stopping") visibility assurance functions, protection and safety functions, or identification functions, such as car navigation systems, car audio systems, and car air conditioning systems. Driving-related functions for "driving, turning, stopping" include, but are not limited to, power transmission systems, steering systems (brakes), buffer system (suspension, bumpers), and fuel systems; visibility assurance functions include headlights and windshield wipers. Protection and safety functions include seat belts, door locking/opening mechanisms, and airbags. Identification functions include turn indicators, hazard lights, and stop lamps. Furthermore, any Equipment used to protect human life, body, or property shall be considered to require high safety standards.
Special Applications	Transportation equipment such as automobiles (excluding standard automotive applications), trains, ships, etc.; traffic signal systems; security and disaster prevention devices; power equipment; various safety devices; medical equipment and systems not directly intended for life support; and other Equipment requiring high safety standards outside of specific applications.
Specific Applications	Aircraft equipment, aerospace equipment, submarine relay equipment, nuclear control systems, and medical devices, equipment or systems intended for life support.

The Product is intended to be used within the scope of Standard Applications, specifically for the application described on the cover page under "Application" (hereinafter referred to as the "Product Application"), and within the specifications, requirements, instructions, environments, and conditions described in the catalog (collectively referred to as the "Conditions"). For example, even if the Product Application states "automotive ●● film," the Product must not be used as a component in Equipment that requires high safety standards.

If the intended use of the Product falls under, or may fall under, any of the following cases, you must consult our representative in advance and enter into a specification appropriate for the intended application, conditions, and the details of the applicable Product. If such prior consultation and execution of a delivery specification do not take place, we reserve the right to refuse to supply the Product.

- 1) If the Product is used for applications other than the Product Application.
- 2) Even within the Product Application, if used outside the specified Conditions, in violation of the Conditions, under unspecified Conditions, or if such use is possible.

## Precautions when ordering and using

### Incoming Inspection

Please conduct an incoming inspection promptly after delivery of the Product. Before or during the incoming inspection, the Product must be stored in accordance with the storage conditions specified in this catalog and with the duty of care of a prudent manager.

### Exceptions to the Purpose of Use

Notwithstanding any other provisions of the Specification or any other agreement, we shall bear no responsibility and/or liability for any Nonconformity or damage arising from or related to any of the following circumstances, or in cases where the Product has been resold, transferred, or otherwise disposed of to any party other than your company:

- 1) Following instructions regarding specifications, standards, or handling methods from any party other than our company.
- 2) Any modification, alteration, or repair of the product's structure, performance, specifications, or other attributes made after shipment by our company.
- 3) Any event that could not be foreseen using the technology that was commercially available at the time of shipment by our company.
- 4) Use, storage, or handling (collectively the "Use, etc.") that does not meet the Conditions, or the Use, etc. that violates the Conditions.
- 5) Continued use of the Product after knowing or being able to know that its performance has deteriorated.
- 6) Failure to implement appropriate safety design measures such as redundant design, fire-spread prevention design, or malfunction prevention design.
- 7) Events caused by other products in which the Product is incorporated or resulting from such incorporation.
- 8) Events caused by other materials, components, circuits, devices, software, or other products combined with the Product, or resulting from such combinations.
- 9) Natural disasters or other force majeure events.
- 10) Use of the Product for applications other than the Product Application.
- 11) Any other causes not attributable to our company.

### Other Matters

#### ■ Intellectual Property Matters

The technical information contained in this catalog, including representative characteristics of the Product and example application circuits, is provided for reference purposes only. Such information shall not be construed as granting any license or rights under any intellectual property owned by the Company, its affiliated entities, or any third party.

Accordingly, the Company shall bear no liability for any issues arising in connection with third-party intellectual property rights resulting from the use of the aforementioned technical information.

#### ■ Handling of Information

Any specification documents, technical materials, evaluation results, samples, or other information provided by the Company to the Customer in connection with the Product shall constitute the Company's confidential information. Such information shall not be used for any purpose other than the use of the Product and shall not be disclosed or provided to any third party without the Company's prior written consent.

#### ■ Governing Law and Dispute Resolution

This catalog shall be governed by and construed in accordance with the laws of Japan.

Any and all disputes, claims, or disagreements arising out of or in connection with this catalog, including any breach thereof, shall be finally resolved through arbitration. The seat of arbitration (including any subsequent arbitration filed during the pendency of the initial arbitration) shall be Osaka, Japan. The arbitration shall be administered by The Japan Commercial Arbitration Association (JCAA) and conducted in accordance with its Commercial Arbitration Rules.

#### ■ Export control

When providing technical documentation related to this product or its technology to exporters or non-resident individuals, please comply with the relevant laws, regulations, and rules of the applicable countries.

#### ■ Language

This catalog may be prepared in Japanese and in one or more other languages. In the event of any discrepancy or inconsistency in interpretation between the Japanese version and any other language version, the Japanese version shall prevail.